NASA's Advanced Information Systems Technology (AIST) Program
Support to Cyberinfrastructure from On-orbit to Data Exploitation

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NASA's Advanced Information Systems Technology (AIST) Program has supported the earth science technology objectives for over 15 years. Recent NASA developments in technology roadmaps, data containers and models, mission control center concepts, and partnerships with other NASA, NSF and Government organizations and ESIP will be reviewed and discussed. New developments to independently test and evaluate technology advances and their impact on the ability of the community to influence R&D Projects will be described along with plans for the next five years of technology innovations in advancing Earth Science Cyberinfrastructure.

AIST Projects Plotted Against their TRL and Relevant Phase of the Data Life Cycle

NAME: Flight Control   PI: Future   AIST ID: A
TRL: **2 to 6**   Phase: **Generate-Sensor/Spacecraft Control**
TITLE: **Requirements for Sensor/Spacecraft Control IT Capabilities**
There is a growing demand for measurements of transient phenomena that requires real-time aiming/pointing/staring of instruments or coordination among spacecraft with only limited human supervision. Planning as well as operational control are needed. These require the ability to automate operations using instrument output without the latency restrictions imposed by earthbound processing. Further information can be obtained in NASA's Technology Roadmaps, particularly the Modeling, Simulation, Information Technology and Processing Technology Area Roadmap (TA-11).
SESSIONS:

NAME: Data Analysis   PI: Future   AIST ID: B
TRL: **2 to 6**   Phase: **Exploit- Data Analysis**
TITLE: **Requirements for IT Data Analysis Capabilities**
The growth in volume of NASA Earth Science Data and Model Output necessitate the use of automated analysis tools. The value of machine learning and artificial intelligence in sifting through large volumes of dissimilarly formatted data has established credibility in particle physics and financial markets. Limited initial experiments in earth science have demonstrated the ability to improve the quality and statistical basis of scientific discovery in this domain, also. Successful projects involve collaboration between data scientists and domain scientists to define clearly a problem which lends itself to this type of tool. The proper analysis of large volumes of data from different sources can significantly reduce the uncertainty in results.
SESSIONS:

NASA EARTH SCIENCE DIVISION
INFORMATION TECHNOLOGY PROGRAMS
PURPOSE- DECONFLICT ITR&D PROGRAMS FOR AIST 2016

NAME: iiSCE   PI: Rosen   AIST ID: 11-0022
TRL: 6   Phase: Exploit-Secondary Products
TITLE: iiSCE: InSAR Scientific Computing Environment on the Cloud. Additionally SAR SCP Foundry
SESSIONS: IN43B-1734

NAME: Hurricanes   PI: Hristova-Veleva   AIST ID: 11-0027
TRL: 6   Phase: Exploit-Secondary Products
TITLE: Fusion of Hurricane Models and Observations: Developing the Technology to Improve the Forecasts
SESSIONS: IN51C-05, IN51B-1811

NAME: Bock   AIST ID: 11-0072
TRL: 5   Phase: Exploit-Secondary Products
TITLE: Next-Generation Real-time Geodetic Station Sensor Web for Natural Hazards Research and Applications
SESSIONS:

NAME: Data Fusion   PI: Braverman   AIST ID: 11-0018
TRL: 3   Phase: Exploit-Secondary Products
TITLE: Multivariate Data Fusion and Uncertainty Quantification for Remote Sensing
SESSIONS: A41-0192

NAME: MUDROD   PI: Yang   AIST ID: 14-0082
TRL: 5 to 7   Phase: Exploit-Data Analysis
TITLE: Mining and Utilizing Dataset Relevancy from Oceanographic Dataset (MUDROD) Metadata, Usage Metrics, and User Feedback to Improve Data Discovery and Access
SESSIONS: IN51B-1809, IN43B-1735, IN31C-1774, IN51B-1812, IN41D-06, PA53A-2237, IN43B-1726, IN31C-1772

NAME: Flooding   PI: Brakenridge   AIST ID: 14-0074
TRL: 3 to 5   Phase: Exploit-Application Use
TITLE: Global Flood Risk From Advanced Modeling and Remote Sensing in Collaboration With Google Earth Engine
SESSIONS: IN31D-05, IN13D-1968

NAME: Quantum   PI: Halem   AIST ID: 14-0096
TRL: 2 to 4   Phase: Generate Compute Environment
TITLE: Feasibility Studies of Quantum Enabled Annealing Algorithms for Estimating Terrestrial Carbon Fluxes from OCO-2 and the LIS Model
SESSIONS: IN31A-175B, IN51B-1813

NAME: Pattern-based GIS   PI: Stepinski   AIST ID: 14-0027
TRL: 3 to 5   Phase: Exploit-Data Analysis
TITLE: Pattern-based GIS for Understanding Content of very large Earth Science datasets
SESSIONS:

NAME: DEREChOS   PI: Kuo   AIST ID: 14-0056
TRL: 3 to 5   Phase: Exploit-Data Analysis
TITLE: DEREChOS: Data Environment for Rapid Exploration and Characterization of Organized Systems
SESSIONS: IN41C-1707∂

NAME: Discovery   PI: Pankratius   AIST ID: 14-0036
TRL: 2 to 5   Phase: Exploit-Data Analysis
TITLE: Computer-Aided Discovery of Earth Surface Deformation Phenomena
SESSIONS: IN41C-1707∂

NAME: Climate Impact   PI: Das   AIST ID: 14-0115
TRL: 4 to 5   Phase: Exploit-Data Analysis
TITLE: Uncovering Effects of Climate Variables on Global Vegetation
SESSIONS: IN41C-1707∂

NAME: CRM   PI: Tao   AIST ID: 14-00022
TRL: 2 to 5   Phase: Exploit-Storage
TITLE: Empowering Data Management, Diagnosis, and Visualization of Cloud-Resolving Models by Cloud Library upon Spark and Hadoop
SESSIONS: IN51A-1794

NAME: NAIADS   PI: Lukashin   AIST ID: 14-0014
TRL: 3 to 6   Phase: Exploit-Data Analysis
TITLE: NASA Information And Data System (NAIADS) for Earth Science Data Fusion and Analytics
SESSIONS:

NAME: LIS   PI: Peters-Lidard   AIST ID: 11-0013
TRL: 6   Phase: Exploit-Secondary Products
TITLE: A mission simulation and evaluation platform for terrestrial hydrology using the NASA Land Information System (LIS)
SESSIONS: H41L-02

NAME: SpaceCubeX   PI: French   AIST ID: 14-0049
TRL: 3 to 5   Phase: DM-Characterize
TITLE: SpaceCubeX: A Hybrid Multi-core CPU/FPGA/DSP Flight Architecture for Next Generation Earth Science Missions
SESSIONS: IN41C-1707

NAME: Large ensemble   PI: Clark   AIST ID: 14-0088
TRL: 3 to 5   Phase: Generate – Model Management
TITLE: Development of Computational Infrastructure to Support Hyper-resolution Large-ensemble Hydrology Simulations from Local-to-Continental Scales)
SESSIONS: H23E-1620, H33E-1655, H13R-03

NAME: CMDA   PI: Lee   AIST ID: 14-0032
TRL: 3 to 5   Phase: Generate: Model Management
TITLE: Climate Model Diagnostic Analyzer (CMDA)
SESSIONS: IN31A-1753, IN31A-1754, IN31A-1753

NAME: MPC   PI: Lieber   AIST ID: 14-0110
TRL: 2 to 4   Phase: Generation- Sensor Control
TITLE: Model Predictive Control Architecture for Optimizing Earth Science Data Collection
SESSIONS:

NAME: SciSpark   PI: Mattman   AIST ID: 14-0034
TRL: 3 to 5   Phase: DM-Movement
TITLE: SciSpark: Highly Interactive and Scalable Model Evaluation and Climate Metrics for Scientific Data and Analysis
SESSIONS: IN53C-01

NAME: AMIGHO   PI: Larson   AIST ID: 14-0004
TRL: 4 to 5   Phase: DM-Stewardship
TITLE: Automated Metadata Ingest for GNSS Hydrology within OODT
SESSIONS: IN41C-1707∂

NAME: Mission Design   PI: Lemoigne   AIST ID: 14-0053
TRL: 2 to 4   Phase: Generation: Mission Planning
TITLE: Tradespace Analysis Tool for Designing Earth Science Distributed Missions
SESSIONS:

NAME: Multi-channel   PI: Ivancic   AIST ID: 14-0025
TRL: 2 to 6   Phase: DM-Movement from Space
TITLE: Multi-channel Combining for Airborne Flight Research using Standard Protocols
SESSIONS:

NAME: SAR Analytics   PI: Hua   AIST ID: 14-0109
TRL: 3 to 4   Phase: Exploit-Product Generation
TITLE: Agile Big Data Analytics of High-Volume Geodetic Data Products for Improving Science and Hazard Response
SESSIONS:

NAME: UAV   PI: Campbell   AIST ID: 14-0090
TRL: 4 to 5   Phase: Generation: Sensor Management
TITLE: Next Generation UAV Based Spectral Systems for Environmental Monitoring
SESSIONS: IN41C-1707∂

NAME: ODYSSEUS   PI: Gleason   AIST ID: 14-0095
TRL: 3 to 5   Phase: DM-Characterize
TITLE: Ontology-based Metadata Portal for Unified Semantics (OlyMPUS)
SESSIONS: IN41C-1707

NAME: Dark Data   PI: Ramachandran   AIST ID: 14-0006
TRL: 2 to 3   Phase: DM-Characterize
TITLE: Illuminating the Darkness: Exploiting Untapped Data and Information Resources in Earth Science
SESSIONS: IN23E-07

NAME: OceaneXtremes   PI: Huang   AIST ID: 14-0028
TRL: 2 to 4   Phase: Exploit: Data Analysis
TITLE: Oceanographic Data-in-Analysis Portal
SESSIONS: IN51B-1910, IN23D-1755, IN51B-1810, IN31C-1771, In31C-1783, IN51B-1812, IN21D-1709

Legend

49	AIST Project Sequence Number (Green=AIST14) (Orange=AIST11) (Blue=Future Needs)
Applied Sci	NASA's Earth Science Division (ESD) Applied Sciences Program
Breadbd	Breadboard prototype
CAL/VAL	Calibration/Validation of data products and instruments
CMAC	NASA's Computational Modeling & Algorithm & Cyberinfrastructure Program
COM	Commercial
Crit	Critical
DAAC	NASA's Digital Active Archive Centers
ESDIS	NASA's Earth Science Data and Information System Project
Env	Expected operating environment for the System
FEMA	US Federal Emergency Management Agency
FLT	Flight
GISS	GISS
GMAO	Goddard Modeling and Assimilation Office
Gnd	Ground
HEC	NASA's High End Computing Program
HW	Hardware
LIS	NASA's Land Information System at Goddard Spaceflight Center
Lab Val	Validation in a laboratory environment
MAP	NASA's Modeling and Analysis Program
MEASURES	M
Mgt	Management
NARA	US National Archives and Records Administration
NOAA	US National Oceanographic and Atmospheric Administration
NWS	US National Weather Service
Op Use	Operational Use
Pre-OA	Pre-Phase A Program
R&A	NASA's Earth Science Division Research and Analysis Programs
RCME	Regional Climate Modeling environment
SCAN	NASA's Space Communications and Navigation Program
TRL	Technology Readiness Level
USGS	US Geological Survey

*Notes and References:
1. **TRL** is a commonly used measure of the maturity of a technology. The criteria for successive levels is described at http://esto.nasa.gov/files/trl_definitions.pdf

2. Data Life Cycle Phases are described at 2015 IEEE Big Data Conference in Santa Clara, CA. More information available at **http://ieee-bigdata-earthscience.jpl.nasa.gov/**

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